

## CLAIMS

We claim:

1. A composition comprising a cationic salt of a weak acid, where the composition is metal atom or ion free and free of heteroatoms, except O or O and S and has volatile combustion products.

2. The composition of claim 1, wherein the weak acid is selected from the group consisting of carboxylic acids, phenols, half esters of sulfuric acid, and acidic hydroxy compounds and mixtures and combinations thereof, and the cationic counterion is selected from the group consisting of oxonium ions, sulfonium ions, sulfoxonium ions and mixtures and combinations thereof.

3. The composition of claim 1, wherein the weak acid is selected from the group consisting of carboxylic acids and acidic hydroxy compounds and mixtures and combinations thereof, and the cationic counterion is selected from the group consisting of sulfonium ions, sulfoxonium ions and mixtures and combinations thereof.

4. The composition of claim 3, wherein the carboxylic acid is selected from the group consisting of mono-, oligo-, or polycarboxy alkanes, alkenes, or alkynes, mono-, oligo- or polycarboxy cycloalkanes, cycloalkene, cycloalkynes, mono-, oligo-, or polycarboxy aromatics, heteroatom-containing analogs thereof, where the heteroatoms are O and/or S, or mixtures or combinations thereof; wherein the sulfonium ions are selected from the group consisting of R,R',R"-sulfonium ions, where R, R' and R" are the same or different alkyl group having from 1 to about 30 carbon atoms, aryl group having from 6 to about 30 carbon atoms, aralkyl group having from 7 to about 30 carbon atoms, alkaryl group having from 7 to about 30 carbon atoms, a polyalkylene glycol group, a polyalkyleneoxide group, or mixtures or combinations thereof; and wherein the sulfoxonium ions are selected from the

group consisting of R,R',R"-sulfoxonium ions, where R, R' and R" are the same or different alkyl group having from 1 to about 30 carbon atoms, aryl group having from 6 to about 30 carbon atoms, aralkyl group having from 7 to about 30 carbon atoms, alkaryl group having from 7 to about 30 carbon atoms, a polyalkylene glycol group, a polyalkyleneoxide group, or mixtures or combinations thereof.

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5. The composition of claim 3, wherein the acidic hydroxy compounds include, without limitation, mono-, oligo-, or polyhydroxy alkanes, alkenes or alkynes, mono- or polyhydroxy cycloalkanes, cycloalkene, cycloalkynes, or aromatics and heteroatom-containing analogs, where the heteroatoms are O and/or S, or mixtures or combinations thereof; wherein the sulfoxonium ions are selected from the group consisting of R,R',R"-sulfoxonium ions, where R, R' and R" are the same or different alkyl group having from 1 to about 30 carbon atoms, aryl group having from 6 to about 30 carbon atoms, aralkyl group having from 7 to about 30 carbon atoms, alkaryl group having from 7 to about 30 carbon atoms, a polyalkylene glycol group, a polyalkyleneoxide group, or mixtures or combinations thereof; and wherein the sulfoxonium ions are selected from the group consisting of R,R',R"-sulfoxonium ions, where R, R' and R" are the same or different alkyl group having from 1 to about 30 carbon atoms, aryl group having from 6 to about 30 carbon atoms, aralkyl group having from 7 to about 30 carbon atoms, alkaryl group having from 7 to about 30 carbon atoms, a polyalkylene glycol group, a polyalkyleneoxide group, or mixtures or combinations thereof.

6. The composition of claim 1, wherein the weak acid is selected from the group consisting of diethylmalonic acid, 1,2,3,4-butane tetracarboxylic acid, 3-hydroxy-2-methyl-4-pyrone, 4-hydroxy benzoic, carbonic acid, and cis-1,2,3,4,5,6-cyclohexyl hexacarboxylic acid; wherein the cation is selected from the group consisting of trimethylsulfonium ion, triethylsulfonium ion, tripropylsulfonium ion and tributylsulfonium ion.

7. A buffer composition for use in analytical systems having gas-phase or vapor-phase

2 element-specific detectors (ESDs), where the composition comprises a compound comprising  
3 a cationic salt of a weak acid, where the composition is metal-atom-free and free of  
4 heteroatoms, except O and/or S and has volatile combustion products.

1 8. The composition of claim 7, comprising at least two compounds and covering a  
2 desired pH range between about 1 and about 13.

1 9. The composition of claim 7, wherein the weak acid is selected from the group  
2 consisting of carboxylic acids, phenols, half esters of sulfuric acid, and acidic hydroxy  
3 compounds and mixtures and combinations thereof, and the cationic counterion is selected  
4 from the group consisting of oxonium ions, sulfonium ions, sulfoxonium ions and mixtures  
5 and combinations thereof.

1 10. The composition of claim 7, wherein the weak acid is selected from the group  
2 consisting of carboxylic acids and acidic hydroxy compounds and mixtures and combinations  
3 thereof, and the cationic counterion is selected from the group consisting of sulfonium ions,  
4 sulfoxonium ions and mixtures and combinations thereof.

1 11. The composition of claim 9, wherein the carboxylic acid is selected from the group  
2 consisting of mono-, oligo-, or polycarboxy alkanes, alkenes, or alkynes, mono-, oligo- or  
3 polycarboxy cycloalkanes, cycloalkene, cycloalkynes, mono-, oligo-, or polycarboxy  
4 aromatics, heteroatom-containing analogs thereof, where the heteroatoms are O and/or S, or  
5 mixtures or combinations thereof; wherein the sulfonium ions are selected from the group  
6 consisting of R,R',R"-sulfonium ions, where R, R' and R" are the same or different alkyl  
7 group having from 1 to about 30 carbon atoms, aryl group having from 6 to about 30 carbon  
8 atoms, aralkyl group having from 7 to about 30 carbon atoms, alkaryl group having from 7  
9 to about 30 carbon atoms, a polyalkylene glycol group, a polyalkyleneoxide group, or  
10 mixtures or combinations thereof; and wherein the sulfoxonium ions are selected from the

11 group consisting of R,R',R"-sulfoxonium ions, where R, R' and R" are the same or different  
12 alkyl group having from 1 to about 30 carbon atoms, aryl group having from 6 to about 30  
13 carbon atoms, aralkyl group having from 7 to about 30 carbon atoms, alkaryl group having  
14 from 7 to about 30 carbon atoms, a polyalkylene glycol group, a polyalkyleneoxide group,  
15 or mixtures or combinations thereof.

1 12. The composition of claim 9, wherein the acidic hydroxy compounds include, without  
2 limitation, mono-, oligo-, or polyhydroxy alkanes, alkenes or alkynes, mono- or polyhydroxy  
3 cycloalkanes, cycloalkene, cycloalkynes, or aromatics and heteroatom-containing analogs,  
4 where the heteroatoms are O and/or S, or mixtures or combinations thereof; wherein the  
5 sulfonium ions are selected from the group consisting of R,R',R"-sulfonium ions, where R,  
6 R' and R" are the same or different alkyl group having from 1 to about 30 carbon atoms, aryl  
7 group having from 6 to about 30 carbon atoms, aralkyl group having from 7 to about 30  
8 carbon atoms, alkaryl group having from 7 to about 30 carbon atoms, a polyalkylene glycol  
9 group, a polyalkyleneoxide group, or mixtures or combinations thereof; and wherein the  
10 sulfoxonium ions are selected from the group consisting of R,R',R"-sulfoxonium ions, where  
11 R, R' and R" are the same or different alkyl group having from 1 to about 30 carbon atoms,  
12 aryl group having from 6 to about 30 carbon atoms, aralkyl group having from 7 to about 30  
13 carbon atoms, alkaryl group having from 7 to about 30 carbon atoms, a polyalkylene glycol  
14 group, a polyalkyleneoxide group, or mixtures or combinations thereof.

1 13. The composition of claim 9, wherein the weak acid is selected from the group  
2 consisting of diethylmalonic acid, 1,2,3,4-butane tetracarboxylic acid, 3-hydroxy-2-methyl-4-  
3 pyrone, 4-hydroxy benzoic, carbonic acid, and cis-1,2,3,4,5,6-cyclohexyl hexacarboxylic  
4 acid; wherein the cation is selected from the group consisting of trimethylsulfonium ion,  
5 triethylsulfonium ion, tripropylsulfonium ion and tributylsulfonium ion.

1 14. An analytical system for detecting an analyte containing heteroatom other than O

2 and/or S comprising:

3 a combustion zone where an analyte and a buffer composition are converted to their  
4 corresponding volatile combustion products; and

5 a detector capable of detecting at least one of the corresponding volatile combustion  
6 products of the analyte,

7 where the buffer composition comprises a compound comprising a cationic salt of a  
8 weak acid, where the composition is metal-atom-free and free of heteroatoms, except O  
9 and/or S and has volatile combustion products.

1 15. The system of claim 14, further comprising:

2 a analytical separation apparatus selected from the group consisting of a  
3 chromatographic separation apparatus, an electrophoretic separation apparatus, and an  
4 extractive separation apparatus or a flow-injection apparatus.

1 16. The system of claim 14, wherein the detector comprises an element-specific-detector.

1 17. The system of claim 16, wherein the element-specific detectors include nitrogen-  
2 selective gas-phase chemiluminescence detectors, sulfur-selective gas-phase  
3 chemiluminescence detectors, nitrogen-phosphorus thermoionic detectors, electron-capture  
4 detectors, atomic emission plasma detectors, or inductively-coupled plasma-mass  
5 spectrometric (ICP-MS) detectors.

1 18. The system of claim 14, further comprising a transformation zone where at least one  
2 volatile combustion product of the sample is converted into a transformate and a detector  
3 capable of detecting at least one transformate.

1 19. A method comprising the steps of combusting a sample and a buffer composition to  
2 their corresponding volatile combustion products in a combustion zone and detecting at least

one sample volatile combustion products in a detector, where the buffer composition comprises a compound comprising a cationic salt of a weak acid, where the buffer composition is metal-atom-free and free of heteroatoms, except O and/or S and has volatile combustion products.

20. The method of claim 19, further comprising the step of mixing the sample and the buffer composition prior to combustion.

21. The method of claim 19, further comprising the step of converting at least one volatile combustion product of the sample into at least one transformate and detecting at least one of the transformates.

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